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MDA Program Test Structure and FIRE Implementation

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13. ABSTRACT (Maximum 200 words.)
An objectives and metrics structure has been designed for Maritime Domain Awareness tests. This structure has been installed in the NPS FIRE knowledge management system. This report describes the structure and its use for MDA test planning and reporting.

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Executive Summary

The Naval Postgraduate School was contracted by NAVNETWARCOM / SPAWAR PEO C4I to develop objectives and metrics for MDA evaluation, to include Spiral-1 system assessments and follow-on full operational capabilities assessments.

NPS applied a robust method for military testing/experimentation. That method, previously developed for Trident Warrior and other assessment events applies:

- A structure for defining program objectives and goals.
- A structure for defining metrics.
- Methods of specifying data requirements for operational and tactical events.
- Methods of rapidly generating reports from collected data on metrics pertinent to program objectives and goals

The FORCEnet Innovation and Research Enterprise (FIRE) knowledge management system provides robust support for applying this method and managing the knowledge it produces. In particular, FIRE provides forms for planning and reporting within and across events. It also provides work and collaboration spaces.

NPS applied this method and infrastructure to develop an MDA-specific structure of objectives and metrics. Authoritative MDA documents served as the foundation for this work. This status report:

(1) Describes the NPS method for developing objectives and metrics and their use in test planning.
(2) Defines the framework NPS has developed for MDA assessment.
(3) Presents objectives and metrics that have been defined from MDA program requirements documentation.
(4) Describes FIRE forms and reports that have been created for MDA program use.

The NPS products for MDA will support the full range of required MDA capability testing for Spirals 1, 2, and beyond, including:

- System capabilities
- Systems support for operations
- Operations process capabilities
- Workflow and information flow
- Guidance documents status
- Organization and cross-organization capabilities
- Cross-organization and multi-national agreements and processes
- Human capabilities

Further, this work will enable the Navy to correlate and fuse findings across many dimensions:

- Across test venues
- Across studies of process, system, organization, human, and guidance
- Across experiments, e.g., Trident Warrior, Empire Challenge, and JMMES JCTD.

The work reported here is in process. NPS has developed an MDA-specific framework of objectives and metrics. Further effort is required to develop measures within this framework, apply them at evaluation events, and report results within events and across the MDA program. NPS recommends that the development of measures continue with a specific focus on generating measures for specific events.

1. INTRODUCTION

The Naval Postgraduate School was contracted by NAVNETWARCOM / SPAWAR PEO C4I to develop objectives and metrics for MDA evaluation, to include Spiral-1 system assessments and follow-on full operational capabilities assessments. This report:

(5) Describes the NPS method for developing objectives and metrics and their use in test planning.

(6) Defines the framework NPS has developed for MDA assessment.

(7) Presents objectives and metrics that have been defined from MDA program requirements documentation.

(8) Describes FIRE forms and reports that have been created for MDA program use.

The NPS effort focuses on defining test objectives and their associated metrics to evaluate:

- The operational utility and impact of Spiral 1 technologies
- MDA process capabilities
- Human and organization capabilities
- Quality of MDA CONOPS and TTP documents
- Multi-organization and multi-national agreements

This effort builds on an established method for experiment/test planning[1], and it leverages a special-purpose knowledge management system – FORCEnet Innovation and Research Enterprise (FIRE) – that supports experiment/test planning, results development, and reporting.

Further, the NPS product builds on an authoritative set of MDA resources:

- Campaign Plan for Navy Maritime Domain Awareness Prototypes, 21 Aug 200
- MDA Spiral 1 Overarching T & E Plan, 1 Oct 2007
- Scoping Document, version 4-4, 23 Jan 2008
- Fleet MDA CONOPS, 13 Mar 2007
- MDA Focus Area Brief, ONR S&T Goals presentation, Jul 2007

[1] This process is documented in "FIRE Experiment Planning and Reporting Structure", NPS-IS-07-002, Jul 2007. A second report describes how the products of this process are mapped to JCIDS or other areas of interest: "Mapping Experimental Results to Operational Capabilities," NPS-97-08-001, Nov 2007.

- The MDA Workflow developed by NPS (see the accompanying report) and vetted by representatives of ASN RDA, C3F, COTF, Dept. of the Under Secretary of the Navy, DISA, HFE LLC, JITIC, METRON, MIFCLANT, MIFCPAC, NAVCENT, NAVNETWARCOM, NCIS, NORTHCOM, NPS, NRL, NWDC, ONI, OPNAV, PMW 120, SPAWAR, and MDA Spiral 1 technology experts.

The readers should be aware that this reports documents one of several metrics and measurement efforts for MDA. Those efforts, in combination with the NPS work, define a broad space of MDA metrics. The reader may wish to access these additional efforts if their interests extend beyond the measurement space NPS is addressing. Specifically:

- Measures developed by Mike Shumberger of HFE for the Navy focus on assessment of fleet readiness for MDA operations.
- Measures developed by Fifth Fleet support acquisition and use decisions by operational organizations concerning existing operations.

2. FOUNDATIONS

The MDA products described below are built on a foundation that has two dimensions: objectives and metrics. We define those terms below, and then describe how they are instantiated for MDA.

2.1 Objectives

Objectives define what is to be learned from an investigation. For MDA these objectives are to assess current capabilities or to develop new ones. A logical objective structure enables us to correlate test results from different venues and to relate them to other areas, such MHQ w/MOC. For the MDA effort, NPS developed an objective structure that consists of two substructures: "program" and "test" objectives.

Program Substructure

Program area: A major area of interest to the MDA program. *Example: Detect and Track*

Activity / Focus: An element or activity within a program area. *Example: Ship Detection*

Program objective: A focal element or activity within the MDA activity, *Example: Provide non-radiating ship detection.*

The above is the "program" portion of the structure. It applies to the program as a whole and contains all of the objectives, implied or stated, from the documents listed in Section 1. The Program Objectives for MDA have been input in FIRE so that they can be selected and used, as needed, for specific test venues.

Test Objectives Substructure

Test objective: A focus of one or more test venues. *Example: Provide automated detection of non-radiating ships.*

Objective- Goal(s): A determination to be made or question to be answered at a test venue. Note that objective goals are operationalized by (consist of) situation, specific measures and data (measurements). *Example: Determine if Global Hawk provides accurate and timely detection of non-radiating ships.*

The "test" portion of the structure specifies the objectives and goals to be determined for a particular test venue.

Designing a test involves several more components in addition to the objectives and goals. One also has to define:

- Specific measures
- Data required to produce those measures
- Situations to be set up so that the correct data are captured
- A schedule that combines these components

2.2 Metrics

Metrics are the attributes, measures, and standards associated with an activity, such as ISR or support activity such as network-centric operations.

- **Attributes** are single-word expressions of the characteristics of people, things, or processes. *Example: Timely*
- **Measures** quantify attributes. *Example: Average time from submission of RFI to receipt of requested information.* Measures are of several types:
    - Measures of Effectiveness (MOEs) concern how well a technology, organization, or process performs its functions. *Example: Reliable*
    - Measures of Performance (MOPs) concern a specific parameter of a technology, organization, or process. *Example for "reliable" effects: Robust*
    - Measures of Utility (MOUs) concern how well a technology, organization, or process contributes to a military activity. *Example: Needed*
    - Measures of Readiness (MORs) reflect the combined effectiveness and utility of a system, and its life-cycle plan.
- **Standards** are values that specify a satisfactory performance boundary. *Example: Two hours from submission of RFI to receipt of requested information.*

Attributes and measures have meaning only when associated with a task. For example:

- Task: retrieval of data from a local repository
- Attributes: timely
- Measure: latency (or delay) of retrieved information.

In this case, the task helps to specify the meaning of timeliness. The actual measure of interest completes the specification. This association aspect will be covered more completely in Appendix D.

This complete structure, objectives, goals, metrics, and other planning components that define events and data, are provided in the FIRE planning and reporting system. The system contains input/edit forms and reports that show current contents of the test database. FIRE is described in Section 5.

3. MDA Use-Case: Scenario and Issues

MDA objectives are complex and multi-threaded. We might, for example, want to evaluate VoI (Vessel of Interest) handoff processes, the systems that support the process, and the associated TTP. In the remainder of this report, we describe how we put the structures above, and FIRE, to work to define objectives and metrics in the MDA program. We illustrate this with a use case, which in essence describes the military operations that will be invoked in a study and what we wish to learn from studying them. Once this has been established, we use the MDA objectives and metrics structure to define the specifics of the test(s) to be undertaken.

In this use-case the following operations take place:

- HUMINT identification of a person-of-interest.
- Ship cargo and personnel identification.
- Non-AIS and AIS ship tracking.
- Information processing and sharing for Situation Awareness.
- Vessel-of-Interest handoff across AORs and nations.
- Vessel boarding.

The MDA issues to be investigated are:

- Database access.
- System interoperability.
- Multi-national and multi-agency cooperation agreements.
- CONOPS and TTP sufficiency.
- Information sharing agreements and information interoperability.
- Information quality for SA and decision-making.
- Boarding communications and surveillance capabilities.
- Boarding data and information collection.

As noted above, the use case and issues identify learning objectives. An issue can apply to more than one operation and an operation can address several issues. Table 1 provides a partial listing of the issues to be addresses for each operation.

Operations	Issues (notional, not complete)
HUMINT	Access to injected HUMINT information.
	Timeliness of HUMINT alert.
	Access to human information databases.
Ship Information	Access to ship manifests.
	Ship database access.
	Completeness of ship information
Ship Tracking	Timeliness and accuracy of AIS reports
	Timeliness and accuracy of overhead surveillance.
	Timeliness of identification process.
	Automated reporting capabilities.
VoI Handoff	CONOPS and TTP sufficiency.
	Personnel familiarity with handoff process.
	Timeliness of handoff completion.
	Sufficiency and accuracy of handoff information.
	Automated M2M handoff capabilities.
Information Processing	GUI usefulness/clarity.
	Ability to correlate multi-int information.
	Reachback timeliness and sufficiency.
	Ability to correlate HUMINT with person database.
	Information fusion accuracy.
Information Sharing	Multi-national agreements, sufficiency/constraints.
	Multi-agency agreements, sufficiency/constraints.
	M2M interoperability.
	Content and format interoperability.
	Distributed information fidelity.
Boarding	Available communications bandwidth/throughput.
	Communications security.
	Communications reliability.
	Biometrics kit usability.
	Real-time assessment capabilities.

Table 1. MDA operations and issues for an example use-case.

Note: Some issues in Table 1 are highlighted in yellow. They are addressed in Section 6 below.

We leverage this use case in the remainder of this report. Specifically, we:

- Describe the objectives and metrics structure (Section 4).
- Describe use of FIRE for test planning and reporting (Section 5).
- Address the use-case as an illustration of test planning (Section 6).

4. MDA Objectives and Metrics

The following is the MDA program structure, a specific instantiation of the objectives and metrics structure described above. In Section 6, we describe application of this structure to specific tests. Appendix E describes how this structure correlates with the JCIDS JCAs.

4.1 MDA Objectives

Eight MDA Program Areas have been defined:

- **Detect/Track** – detection and tracking of surface vessels by any means
- **Process** – processing of data and information
- **Analyze/Develop SA** – analysis of processed ship information to provide threat assessment and develop situation awareness
- **Distribute/Share** – distribution and sharing of assessments for course-of-action development and decision-making.
- **Archive/Retrieve** – deploying, maintaining, and updating MDA databases
- **Guidance** – assessment of guidance quality, CONOPS, TTP, directives
- **Workflow** – workflow assessment, including the influences of humans, organizations, and workflow structure

In addition, it was determined that E-MIO operations should be broken out as its own program area from other operations.

- **E-MIO** – operations capability: planning, execution, and information management activities associated with E-MIO

All of the MDA objectives in the reference documents fit within these Areas.

Within each Program Area, several Activities or test foci have been defined. These are presented in Table 2.

Program Area	Activity / Focus
Detect/Track	
	Ship Detection
	Ship Tracking
	Acquire Database Information
	Intelligence Collection
Analyze/Develop SA	
	Develop Profiles
	Request Information
	Classify Vessels
	Prioritize Information
Archive/Retrieve	
	Deploy Repository
	Acquire Information
	Authenticate Information
	Manage Access
	Assure Information
Workflow	
	Task Assignments
	Organization
	Group
	Human
	Multi-Organization Workflow

Program Area	Activity / Focus
Process	
	Identify Ship's Data
	Classify
	Correlate
	Fuse
Distribute/Share	
	Distribution Means
	Collaborate
	Disseminate
Guidance	
	TTP & SOP
	CONOPS
	Standing Orders
	Cross-Organization Agreements
E-MIO Operations	
	Information Acquisition
	Develop Situation Understanding
	Course-of-Action
	Boarding Execution
	Shipboard Collection
	Information Dissemination
	Mission Assessment

Table 2. First two levels of the MDA program objectives structure.

Many of the processes in E-MIO are included in the other Program Areas. However, E-MIO is broken out as its own Program Area at the request of those evaluating MDA. This could be accomplished with other operations, if desired.

Within each Activity / Focus several Program Objectives have been developed. Table 3 presents examples for the Detect/Track Program Area. Also shown is the coding used (e.g., DT-ST.1), which is explained below. The full list is presented in Appendix D.

Program Area / Activity / Focus	Program Objective
DT Detect/Track	
DT-SD Ship Detection	
DT-SD.1	Non-radiating-ship detection
DT-SD.2	Radiating-ship detection
DT-SD.3	Plan & Optimize Collection
DT-SD.4	Automated alerting
DT-ST Ship Tracking	
DT-ST.1	Non-radiating-ship tracking
DT-ST.2	Radiating-ship tracking
DT-ST.3	AIS-broadcasting-ship tracking
DT-ST.4	Handoff
DT-ST.5	All ship tracking
DT-Acq Acquire Database Information	
DT-Acq.1	Local repository retrieval
DT-Acq.2	Remote repository retrieval
DT-Acq.3	Cross-domain retrieval
DT-Acq.4	Weather & Environment
DT-Acq.5	Reachback/RFI

Program Objectives are written in shorthand, with the word "Provide" removed. E.g., DT-SD.1 is "Provide non-radiating-ship detection.

Color is used in the table only to show that the Program Objectives belong to the same Activity/Focus.

Table 3. Example Activity Types for the Monitoring & Collection Activity Category.

4.2 MDA Metrics

As explained above, metrics define the attributes, measures, and standards associated with an activity, such as a network-centric operational or support activity. The measures are enumerated below through their attribute pair. Appendix A contains detailed definition of each attribute. NPS developed the attribute structure for NAVNETWARCOM, which uses it for their CBAs. NPS added Readiness and its components for the MDA program.

Four MOEs form the basis for the structure. They are:

- **Accessible** You can get to it.
- **Reliable** It is there when needed.

- **Capable** It/he/she/they can do the defined job.
- **Usable** You can use it.

Each MOE has a set of included MOP. These 21 MOPs are shown in Table 4.

Effective				
Accessible	**Reliable**	**Capable**	**Usable**	**MOE**
Capacity	Robust	Sufficient	Clear	**MOP**
Available	Persistent	Flexible	Trusted	"
Compatible	Secure	Accurate	Manageable	"
Extensive	Assured	Timely	Relevant	"
Efficient		Reach	Compliant	"
		Automatic	Deployable	"
Military Utility				
Improved	**Needed**	**Applicable**	**Wanted**	**MOU**
Ready				
Effective	**Utility**	**Life Cycle**	**Personnel**	**MOR**
Readiness is a roll up of the component readiness measures.				

Table 4. Attribute structures for effectiveness, utility, and readiness.

Four MOUs were defined:

- **Improved** Improves the performance of operational activities.
- **Needed** Fills a gap in current capabilities.
- **Applicable** Can be applied to activity performance.
- **Wanted** Operational personnel want, will use, the capability.

Note that no MOP equivalents were defined for Military Utility. This is because currently most utility determinations are subjective. Objective determinations can be made, e.g., the number of times a capability is used as a measure for Wanted. The MOPs shown for effectiveness are also appropriate for utility.

In addition, a readiness metric was defined.

- **Ready** Ready is an official procurement term that refers to the system being ready for fielding. As indicated, it is a roll-up of the other fundamental measures and the life-cycle plan (which includes a personnel plan).

5. MDA in the FIRE Knowledge Management System

NPS has developed the FORCEnet Innovation and Research Enterprise (FIRE) to provide complete support for experiment and test planning and reporting. An MDA section has been set up in FIRE, implementing the structure described above. In this chapter, we describe the system's capabilities and how it is used.

It is important to recognize that the objective statements in FIRE are Test Objectives. They are the actual objectives to be achieved and their status addressed in a test venue

5.1 FIRE Structure

FIRE has two basic sections, Planning Forms and Workspace:

Planning Forms

- Detailed planning is accomplished through entries in pre-set forms.
- There are three sets of planning forms
  - Objective
  - Data/Events
  - Results
- Each forms set includes
  - Input/Edit form
  - Report that shows the current planning database content

Workspace

- Contains collaboration capabilities and folders for information to be shared
- Pre-created folders and user defined folders
- Check-in/check-out library for document version control

Following is a depiction of the principal components of the planning forms.

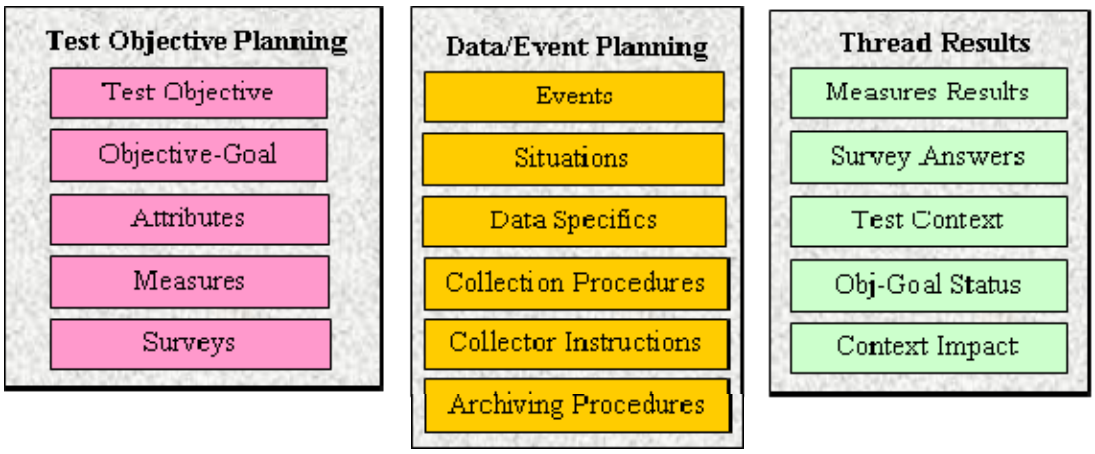

Figure 1. Principal components of the MDA planning forms in FIRE.

To plan a test (see
Figure 2), we use both the forms (left) and the workspace (right) in a sequence such as the one illustrated here (center).

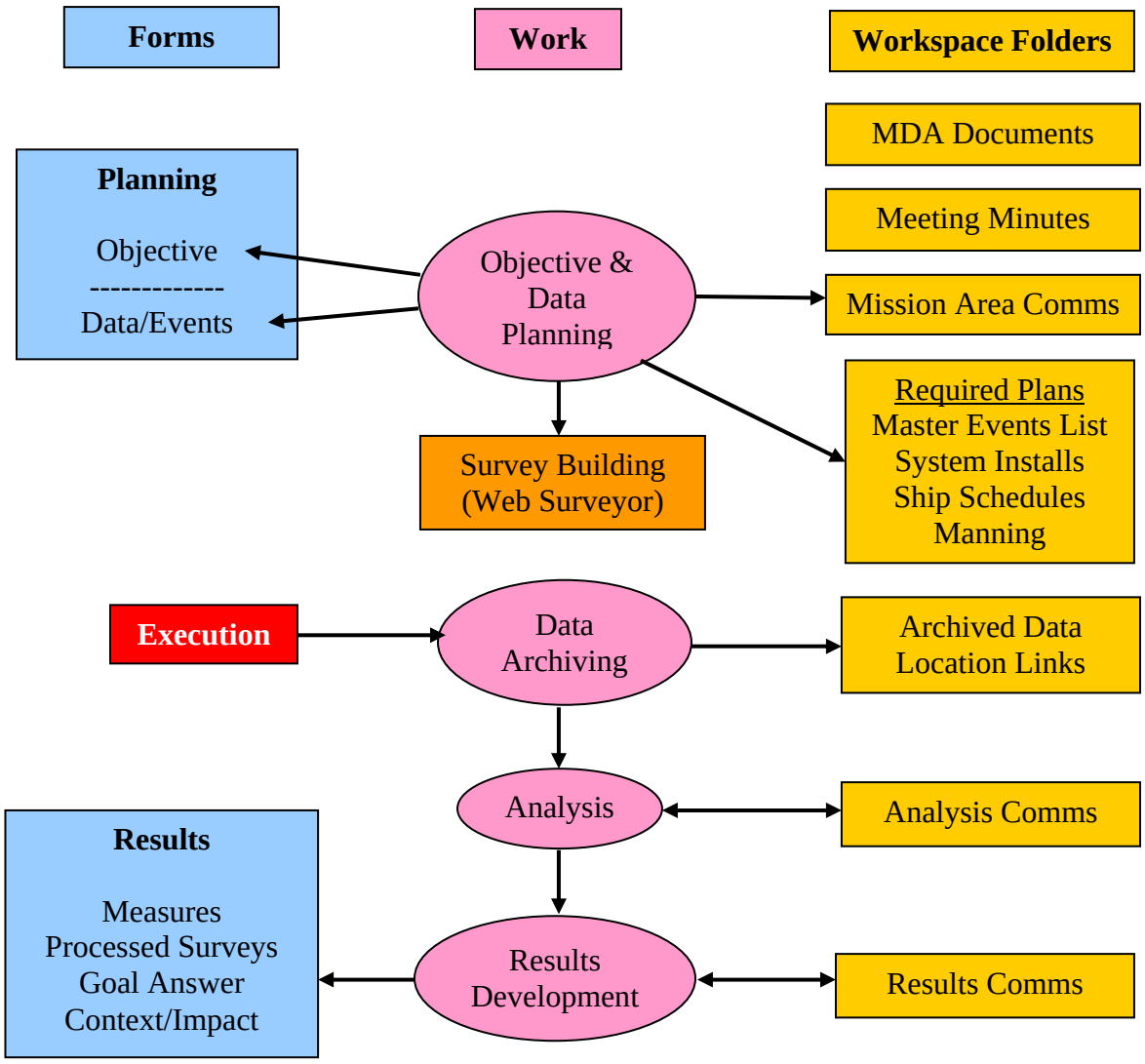

Figure 2. Schematic of FIRE forms and workspace use.

5.2 FIRE Forms Use

The MDA objective planning forms in FIRE have been installed with the following information pre-installed in the objective planning forms. This has been done for each Mission Area.

- Test Objectives
- Objective-Goals
- Goal Attributes
- Measures for each Goal Attribute
- Survey questions for each Goal

It is expected that the pre-installed planning entries will need some modification. Those entries are for the MDA program in general and will need to be made specific for the particular test venue. For example, an objective and objective-goal for ship tracking is written system-agnostic. That is, we have no prior system-specific expectations in our assessment methodology. The particular system being tested in the venue will need to be inserted in the goal statement.

The modification process proceeds as follows for each test to be done:

- Choose the Test Objective to be investigated, e.g., a ship tracking objective.
- Chose the Objective-Goal under that Objective, e.g., system interoperability for handoff.
- Modify the goal statement for
    - Systems to be tested
    - Particular attribute to be determined, e.g., timely, accurate, sufficient
- Specify the exact measure to be determined, e.g., beginning and end points for timeliness
- Specify the data source
- Specify any survey questions, e.g., was information handoff accurate…

The above steps are done using the Objective Planning forms. Details of events and data capture are specified using the Data/Event Planning forms.

Some of these steps will be illustrated for the use-case in Section 6.

As noted above, the FIRE forms include reports of what is contained in the database. There is a report for:

- Each Objective-Goal
- Each of the three forms
- Each Venue

There are not separate FIRE databases for each venue. As test venues are added, its reports are placed above those for preceding venues, including a visual delineation.

6. MDA Use Case: Test Development

The MDA framework defined above is used to develop test objectives, goals, and metrics. Here, we define several MDA program objectives that bear on the use case defined in Section 2. Five issues to be addressed are highlighted in yellow in Table 1. Appendix D contains the complete list of MDA Program Objectives and associated attributes, with an objective code which is used here.

6.1 Issues Addressed and Program Objectives

Table 5 shows the issues addressed here, again highlighted in yellow. The table also includes the corresponding MDA Program Objectives and their codes.

	Code	Program Objective
Ship Tracking		
	Timeliness and accuracy of overhead surveillance	
	DT-ST.1	Non-radiating-ship tracking
	DT-ST.2	Radiating-ship tracking
VoI Handoff		
	CONOPS and TTP sufficiency	
	G-TTP.4	Operational/Tactical Threads
	G-CON.4	Operational/Tactical Threads
	Personnel familiarity with handoff process	
	W-Hum.2	Task Understanding
Information Processing		
	Information fusion accuracy	
	Proc-Fus.2	Develop Ship Folder
	Proc-Crl.1	Multi-Source Fusion
	Proc-Crl.3	Reference Data Fusion
Information Sharing		
	Content and format interoperability	
	DS-Mns.2	Format for Distribution
Boarding		
	Communications reliability	
	DS-Dis.1	Optimize Paths
	DS-Dis.3	Push Information

Note that the Program Objective descriptions in Table 5 are shorthand for the complete objective statements in FIRE.

Table 5. Use-case issues and corresponding MDA Program Objectives.

6.2 Using FIRE for Planning Test Objectives and Objective-Goals

The first letters in the codes shown in Table 5 indicates the Test Area (organized on tabs in FIRE[2]).

- DT = Detect/Track
- Proc = Process Data and Information
- AD = Analyze/Develop Situation Understanding
- DS = Distribute/Share
- DB = Database Archive/Retrieve
- W = Workflow
- G = Guidance
- MIO = E-MIO Operations

For definition of the rest of the code see Appendix D.

Most of the issues shown in Table 5 address supporting technologies. Thus the full Test Objective and Objective-Goal statements address systems. However, there are also two Guidance and one Workflow issues.
Table 6 contains the Test Objective and Objective-Goal statements for each of the issues. Note that the technology objectives begin with the word "provide" or "develop". This is because the purpose of the MDA program is to provide capabilities. Objective-Goals are specific "determinations" that assess the status of the objective.

Systems are referred to as "system SSS" in Table 6. For actual tests the name of the system used would be inserted.

> Actual test Objective-Goals would be written more completely than the illustrations presented here. Those shown here are to illustrate the development process, not for actual use.

Colors are used to easily distinguish a particular Test Objective and its Objective-Goals (simply labeled Goal in the table). Test Objectives colored red: indicate that it was decided during test planning that they would not be attempted, for reasons not given. This is not an unusual occurrence during planning.

[2] At the time of writing this report the Program Objectives and Test Objectives are being formulated and input to FIRE. Thus, the below objectives statements may not be exactly the same as the final FIRE content.

DT-ST.1	Provide automatic tracking and reporting of non-radiating VoI across the full AOR.
Goal A -	Determine the accuracy and timeliness of system SSS VoI tracking.
Goal B -	Determine the number of ships in the AOR that system SSS can simultaneously track.
DT-ST.2	Provide systems that automatically track and report on radiating VoI across the full AOR.
Goal -	Determine the persistence, fraction of time, that system SSS can track each VoI.
G-TTP.4	Develop and evaluate TTP for MDA operations.
Goal A -	Determine which VoI handoff processes are covered by TTP
Goal B -	Determine which VoI handoff situations are covered by TTP
G-CON.4	Develop and evaluate CONOPS for MDA operations.
Goal -	Determine which nation's/unit's roles/responsibilities are covered by CONOPS.
W-Hum.2	Evaluate individual understanding of assigned task performance.
Goal A -	Determine the amount of time required for MOC personnel to accept VoI handoff.
Goal B -	Determine MOC personnel perceived level of understanding of handoff procedures.
Proc-Crl.1	Develop processes for fusing information from multiple intelligence sources.
Goal -	Determine which info sources system SSS can automatically fuse.
Proc-Fus.2	Develop processes for correlating multi-source ship information into one assessment.
Goal -	Determine compatibility of each ship information source with system SSS requirements.
Proc-Crl.3	Develop processes for fusing reference database information with real-time information.
DS-Mns.2	Develop a means for formatting information for distribution to multiple users.
Goal A -	Determine the number of formats that can be automatically generated by system BBB.
Goal B -	Determine accuracy after reformatting.
DS-Dis.2	Provide collaboration capabilities to distributed, disparate operational units.
Goal A -	Determine the number of users system CCC can have in a single collaboration session.
Goal B -	Determine the number of collaboration services provided by system CCC.
Goal C -	Determine the bandwidth required by system CCC.
DS-Dis.3	Push information to distributed, disparate operational units.

Table 6. Use-Case Test Objectives and Objective Goals.

6.3 Additional Use-Case Planning Components

The discussion above illustrates how objectives and goals are planned using the NPS framework and FIRE. As noted in Section 5.1, there is a great deal more detailed planning to be done. Some of these MDA planning components (events, data, etc.) are already in FIRE; many are not. Even those that are there will probably need to be modified to be correct for a specific MDA test. To illustrate the key components of planning, we document the planning for two goals in Table 7. All of the input forms for these components are in FIRE. There are many more planning components than those shown in Table 7.

DT-ST.1 Provide automatic tracking and reporting of non-radiating VoI across the full AOR.	
Goal A - Determine the accuracy and timeliness of system SSS VoI tracking.	
Measures	Accurate: Report location error (km). Timely: Average and maximum time between reports, all ships and VoI.
Data Source	system SSS logs, ship navigation logs.
Survey	Is SSS reporting of ship positions sufficient to maintain SA?
Situations	System SSS in operation. Identified VoI in the AOR.
Goal B - Determine the number of ships in the AOR that system SSS can simultaneously track.	
Measures	Capacity: Number of ship tracks displayed by system SSS. Capacity: Number of ship tracks managed by system SSS.
Data Source	system SSS logs, including display log.
Survey	How many ships can be distinguished in the system SSS display? Can the VoI be distinguished from other ships in the display?
Situations	System SSS in operation. Identified VoI in the AOR.

Table 7. Additional planning components for ship tracking test.

Appendix A
Attribute Definitions

Effective – Effective is an overarching attribute. It refers to how well systems, people, and processes meet their stated purposes. This attribute has meaning only in reference to that purpose. E.g., it is not sufficient to state that a system is effective without also stating at what.

Accessible – Users have access to needed capabilities and information. This includes access to communication means, data and processed information, systems, software, support, etc. Access will often be through a network. This attribute is one of the four MOE; its component MOP follow.

> **Capacity –** Number of users that can have access; number of services that can be provided; capacity of other systems required for its function, primarily bandwidth. Included is information or service throughput.
>
> **Available** – System or capability is ready for use, can be used, when needed. It is possible that a capability can be accessed but cannot be used at that time.
>
> **Compatible** – The system or capability can function with other elements external to it without modification to either. It can be integrated with other systems or capabilities. This can also refer to processes or organizations being compatible or integrated.
>
> **Extensive** – The system or capability is capable of servicing a large number of users, covers a large geographical area, services a large number of user types, provides a number of different types of service.
>
> **Efficient** – The number of steps or effort needed to access and use the service is acceptable. This attribute is inherently comparative. Acceptable normally refers to a standard, or an improvement over what was formerly required. Efficiency can be a ratio, a judgment of (result obtained)/(effort required).

Reliable –The capability or information is there when needed, can be depended on. Human and organization reliability is included. This attribute is one of the four MOE; its component MOP follow.

> **Robust** – The system or process is able to withstand stress or attack. Changes in environment are managed with minimal loss of functionality or effectiveness.
>
> **Persistent** – The system maintains its status over long periods of time (primarily ISR capabilities). Information maintains its content and meaning across processing and distribution means (e.g., tracks).

Secure – The system, process, information, has provisions that prevent unauthorized use, intrusion, or tampering.

Assured – Information is warranted to be correct, the source identified, and non-repudiation in effect. The process is warranted to produce the desired result.

Capable – The system, capability, person, or organization provides the needed services. This attribute is one of the four MOE; its component MOP follow.

Sufficient – What has been provided/received is adequate for the recipient to perform their function. For humans and organizations, the skills available are adequate for task performance. Sufficiency can refer to either quantity or level.

Flexible – The system, process, human, or organization responds easily to the situation or to changing requirements. It is adaptable, can handle/utilize a wide range of types. It is tailorable/customizable to user needs and/or users can make modifications to suite their needs.

Accurate – Information provided is correct, matches reality within acceptable limits. Determinations of accuracy normally require definition of acceptable error limits.

Timely – The occurrence or delivery is within acceptable time limits. This can refer to an elapsed time or to meeting a schedule.

Usable – The system, capability, information, or process can be used. This attribute is one of the four MOE; its component MOP follow.

Clear – How the system or process is to be used is easily understood. Meaning of the information is easily comprehended. Instructions, guidelines, definitions are complete and meaningful.

Trusted – Users believe that the information, process, system, organization, will perform their function in a manner that supports current needs.

Manageable – The system or process can be easily modified or manipulated as needs dictate, often in response to changes in the environment. Included is insuring that the required level of performance is maintained. This includes installation of capabilities.

Relevant – Information provided applies to the current situation. System capabilities are what is needed for current tasks. Processes provide the actions required for current operations.

Compliant – The system or information complies with standards or defined structure and formats. Activities are in conformance with existing CONOPS and TTP.

Military Utility – Military utility is a faux attribute (not actually a description of characteristics), used to express that something contributes to the performance of military operations. It is an overarching attribute. The four measures of utility follow.

Improved – The system, organization, or process improves the conduct of military operations for which they were designed.

Needed – The system, organization, or process fills a gap an identified gap.

Applicable – The system, organization, or process is pertinent to conduct of the operation. Its capabilities match the needs and conduct of the operation.

Wanted – Operational personnel want the capability and utilize it. They do not currently have the capability or would rather use it in place of other available capabilities.

Appendix B
MDA Test Program Tracking

Two types of program tracking are provided:
- Objectives and attributes being evaluated, by test venue
- Planning details for each test venue

These tracking spreadsheets are placed in a workspace folder for easy access.

Table 8 shows a small section of the objective and attribute tracking spreadsheet. Its characteristics are:
- A sheet for each Test Area
- Program objective structure Attribute assignments for each Objective Type (indicated by an "X")
- A row for each venue (rows added as venues added)
- Attributes to be evaluated (indicated by a "P")
- Attributes for which results have been obtained (indicated by an "R")

Use of the "P" and "R" indicators allows the spreadsheet to be used to track both planning and after-test results production. The Ps and Rs shown in the spreadsheet are notional, for illustration, not actual assignments.

Table 9 shows an example of the objective and measures planning spreadsheet. There is one sheet per venue. All of the entries shown are notional, not real. Only those MDA program objectives that are planned to be tested will be shown on these sheets. Spreadsheet contents are:

- MDA Obj # — Objective # from the objective structure.
- Objective Type — Objective short title from the objective structure.
- Workflow Node # that is/are being exercised for this Test Goal. — Node #(s) from the workflow architecture
- Workflow Node Name — Name of the workflow node.
- Operational Organization Cmd. — Identification of which Command(s) will be participating in this objective test.
- Operational Organization Cell within the Command that will be participating in this objective test (for data capture). — Identification of the location(s)/Cell(s)
- Supporting Systems test objective. — System(s) that will be used in support of the

- Test Objective — Specific objective for that Objective Type that will be tested. Goals statements that contain the Attributes are in FIRE.
- Test Measures determined — Specific Measure(s) whose value will be for each Attribute.

Objective Category / Objective Type		Accessible	Capacity	Available	Compatible	Extensive	Efficient	Reliable	Robust	Persistent	Secure	Assured	Capable	Sufficient	Flexible	Accurate	Timely	Reach	Automatic	Usable	Clear	Trusted	Manageable	Relevant	Compliant	Deployable	Improved	Needed	Applicable	Wanted	Ready
		MOE	MOP					MOE	MOP				MOE	MOP						MOE	MOP					MOU					MOR
DT	**Detect/Track**																													
DT-SD	**Ship Detection**	X	X			X	X			X			S			X	X	X	X						X	X	X		X	X
	TW-08	R	R										R			R	R								R	R	R		R	
	SIMEX					P	P			P						P	P	P	P											
	SEACAT	P	P			P	P			P						P														
	Venue-X																													

Table 8. Objective and attribute assessment planning, by venue.

MDA Planning Summary

Venue: name here

MDA Obj #	Program Objective	Workflow Node #	Node Name	Operational Organization Command	Operational Organization Cell	Supporting Systems	Test Objective	Test Measures
DT-SD.2	Radiating-ship detection	WF-26	ISR Control	PACFLT	zzzz	CMA MASTER	Determine the number of ships that can be detected and reported.	**Capacity**: Number of ships reported/hour. **Accurate**: Reporting CEP, nmi.
DT-ST.4	Handoff	xxxxx	yyyyy	CENTCOM PACFLT NCIS	N2 N2 CT Cell	CMA AAA	Determine if handoff is efficient.	**Automatic**: M2M handoff, y/n. **Efficient**: time required for handoff (hr); number of steps required for a handoff. **Sufficient**: percent of tracking information transmitted.
						CENTRIX		**Capacity**: coalition throughput.

Table 9. Venue objectives and measures planning.

Appendix C
Task / Attribute / Measure Relationships

As noted in Section 2.2, attributes and measures do not stand alone. They have meaning only when associated with an activity or task. Figure 3 shows the various types of task, attribute, and measure associations that are encountered in military operations assessments. It is useful to keep these associations in mind when developing MDA capability tests. It is not sufficient to test only system performance. It is also necessary to test the processes that systems serve, and the humans and organizations that execute the processes. The relationships shown in Figure 3 illustrate the types of determinations that should be made.

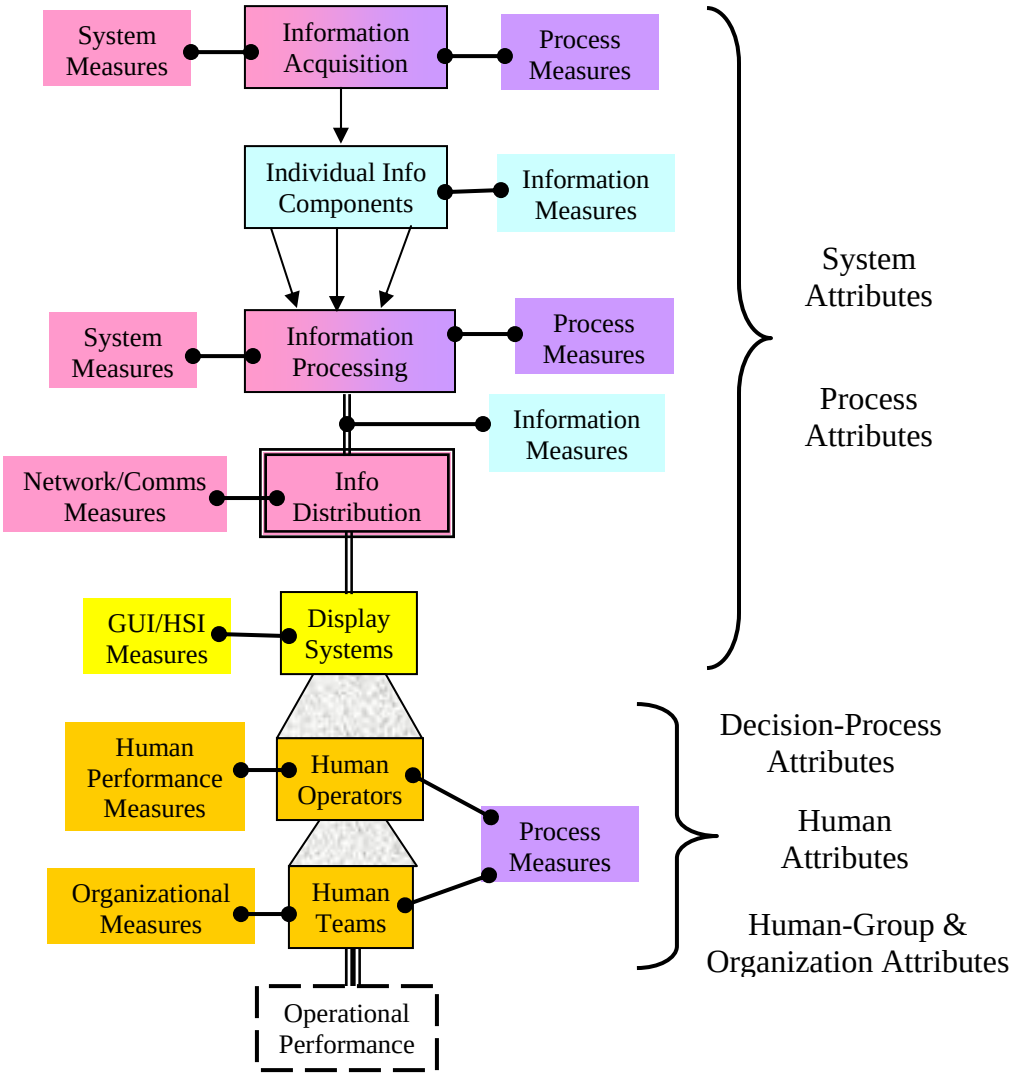

Figure 3. Attribute and measure types and relationships to systems and activities.

Not all associations can be shown in the figure, e.g., collaboration system performance is not shown associated with human decision processes.

The following is an example of task/attribute/measure interdependence is taken from recent development work on the NNWC Capabilities List for Joint Net-Centric Operations.

Attribute = Timely MOP = Timeliness
- Task = RFI response
  - Measures = a. Time from submission of RFI to receipt of information.
    b. Time information waits in queue for transmission.
    c. RFI processing time.
- Task = network management
  - Measures = a. Time to switch channels.
    b. Time from request to receipt of access.
- Task = information processing
  - Measures = a. Average time to develop aim-point.
    b. Fraction of mensurated targets that meet MAAP cut-off.

Appendix D

Program Objectives, Attributes, and Test Goals

The structures, objectives, and metrics that have been developed for MDA testing are "program objectives". This means that they contain the overall objectives and metrics of the program. As has been described in this report, a given test venue will have a set of specific objectives, goals, measures, and data. These specifics fit within, and are derived from, the overall program structure.

Table 10 shows an example of defined test Goals, attributes and measures for DT-SD.1 and SD.4, non-radiating ship detection and automated alerting, respectively (shown in yellow in the figure). These goals are actual assignments derived from the resource documents. The thresholds listed come from the ONR S&T plan, as indicated.

Goals and measures have been defined for all of the MDA Program Objectives. They can be found in FIRE. They can be used directly for tests, or SMEs can design other goals and that fit within the Program Objectives structure.

Goal	Attribute	Measures	Threshold	Source
DT Detect/Track				
DT-SD Ship Detection				
DT-SD.1 Non-radiating-ship detection				
Determine Large Ship Detection Range and Accuracy	Reach Accuracy	Detection Range (mi) Location CEP (mi)	2000 mi 5 mi	S&T
DT-SD.2 Radiating-ship detection				
DT-SD.3 Plan & Optimize Collection				
DT-SD.4 Automated alerting				
Is Large Ship Detection alerting timely?	Timely	Time from detection to alert (hr)	4 hr	S&T

Table 10. Specific Goals to be evaluated and their attributes and measures.

The following tables list the full MDA objectives structure. Table 11 included, for each Program Area, the Activity/Focus and Program Objectives (in condensed statements). Table 12 has the principal attributes and brief indications of application for each Activity/Focus. These attributes apply to all of the activity Program Objectives and the specific ones to be used are chosen during Test Objective and goal planning.

Table 11. Complete listing of Program Areas, Activities / Focus, and Program Objectives (on following pages 28-31).

Program Area Activity / Focus	Program Objective
DT	**Detect/Track**
DT-SD	**Ship Detection**
DT-SD.1	Non-radiating-ship detection
DT-SD.2	Radiating-ship detection
DT-SD.3	Plan & Optimize Collection
DT-SD.4	Automated alerting
DT-ST	**Ship Tracking**
DT-ST.1	Non-radiating-ship tracking
DT-ST.2	Radiating-ship tracking
DT-ST.3	AIS-broadcasting-ship tracking
DT-ST.4	Handoff
DT-ST.5	All ship tracking
DT-Acq	**Acquire Database Information**
DT-Acq.1	Local repository retrieval
DT-Acq.2	Remote repository retrieval
DT-Acq.3	Cross-domain retrieval
DT-Acq.4	Weather & Environment
DT-Acq.5	Reachback/RFI
DT-Int	**Intelligence Collection**
DT-Int.1	Collect Requirements
DT-Int.2	Research RFI
DT-Int.3	Validate & Prioritize Req.
DT-Int.4	Synchronize Collection Req.
DT-Int.5	Simulate ISR Plan
DT-Int.6	Collection Plan
DT-Int.7	HUMINT
DT-Int.8	Alerting / I&W
DT-Int.9	PED

Program Area Activity / Focus	Program Objective
Proc	**Process Data & Information**
Proc-ID	Identify Ship's Data
Proc-ID.1	Ship Characteristics
Proc-ID.2	Cargo
Proc-ID.3	Track History
Proc-ID.4	Ship Infrastructure
Proc-ID.5	Personnel
Proc-ID.6	ID Information Gaps
Proc-Cfy	Classify Information
Proc-Cfy.1	Data Pedigree
Proc-Cfy.2	Data Currency
Proc-Cfy.3	Information Validity
Proc-Cfy.4	Assign Track ID
Proc-Crl	Correlate Information
Proc-Crl.1	Multi-Source
Proc-Crl.2	Ship Information
Proc-Crl.3	Reference Data
Proc-Crl.4	Intelligence information
Proc-Crl.5	Track Information
Proc-Fus	Fuse Information
Proc-Fus.1	Format Information
Proc-Fus.2	Develop Total Ship Folder
Proc-Fus.3	Attach Meta-Data

Program Area **Activity / Focus**	Program Objective
Analyze/Develop SA	
Develop Profiles	
AD-Prof.1	Develop Behavior Profiles
AD-Prof.2	Develop Threat Profiles
AD-Prof.3	Correlate With Ship Information
Request Information	
AD-Req.1	Prioritize Information Gaps
AD-Req.2	Request ISR Collection
AD-Req.3	Request Database Information
AD-Req.4	Request HUMINT
Classify Vessels	
AD-Cfy.1	Classify Ships
AD-Cfy.2	Anomaly Detection
AD-Cfy.3	Identify VoI
AD-Cfy.4	Classify VoI
Prioritize Information	
AD-Pri.1	Prioritize Information
AD-Pri.2	Prioritize Distribution

Program Area Activity / Focus	Program Objective
Distribute/Share	
Distribution Means	
DS-Mns.1	Select Distribution Means
DS-Mns.2	Format for Distribution
DS-Mns.3	Select / Authorize Recipients
Collaborate	
DS-Coll.1	Authorize Participants
DS-Coll.2	Prepare Information
DS-Coll.3	Display Information
DS-Coll.4	Manage Collaboration
Disseminate	
DS-Dis.1	Optimize Distribution Paths
DS-Dis.2	Update Databases
DS-Dis.3	Push Information
DS-Dis.4	Alert Recipients

Program Area **Activity / Focus**	Program Objective
Database Archive/Retrieve	
Deploy Databases	
DB-Dep.1	Local Repository
DB-Dep.2	Central Repository
DB-Dep.3	Multi-Level Guards
DB-Dep.4	Cross-Domain Repositories
Acquire Information	
DB-Acq.1	Human
DB-Acq.2	Ship
DB-Acq.3	Ship Status / Tracks
DB-Acq.4	Environment
DB-Acq.5	Cargo
DB-Acq.6	Intelligence

Program Area Activity / Focus	Program Objective
Guidance	
TTP & SOP	
G-TTP.1	Distribution
G-TTP.2	Operations Coverage
G-TTP.3	Situation Coverage
G-TTP.4	Operational/Tactical Threads
G-TTP.5	Technology Inclusion
CONOPS	
G-CPS.1	Command Relationships
G-CPS.2	Operations Coverage
G-CPS.3	Situation Coverage
G-CPS.4	Operational/Tactical Threads
G-CPS.5	Technology Inclusion

Authenticate Information	
DB-Ath.1	Authenticate Source
DB-Ath.2	Assure Source
DB-Ath.3	Attach Metadata
DB-Ath.4	Assure Information Quality
Manage Access	
DB-Acc.1	Authorize Users
DB-Acc.2	Profile Users
DB-Acc.3	Provide/Control Access
Assure Information	
DB-Ass.1	Monitor Repository Status
DB-Ass.2	Protect Repositories
DB-Ass.3	Detect Unauthorized Access
DB-Ass.4	Detect Information Defects
DB-Ass.5	Status Alerting
DB-Ass.6	Failover
DB-Ass.7	Repair Defects

G-CPS.6	Quality of Instructions
Standing Orders	
G-SO.1	Distribution
G-SO.2	Match to Situation
G-SO.3	Updating
G-SO.4	Quality of Orders
Cross-Organization Agreements	
G-CO.1	Multi-Command
G-CO.2	Multi-Department
G-CO.3	Multi-National

Program Area **Activity / Focus**	Program Objective
Workflow	
Task Assignments	
W-Arch.1	Task Organization
W-Arch.2	Information Flow
W-Arch.3	Prioritization
W-Arch.4	Workflow
Organization	
W-Org.1	Organization Structure
W-Org.2	Command Relationships
W-Org.3	Organization Dynamics
W-Org.4	Situation/Organization Match
W-Org.5	Communications Structure
W-Org.6	Adaptation
W-Org.7	Performance
Group	
W-Grp.1	Group Competence
W-Grp.2	Activities Understanding
W-Grp.3	Situation/Group Structure Match
W-Grp.4	Performance

Program Area Activity / Focus	Program Objective
E-MIO Operations	
Information Acquisition	
MIO-Acq.1	Vessel Characteristics
MIO-Acq.2	Threat Assessment
MIO-Acq.3	Rules and Orders
MIO-Acq.4	Available Assets Status
MIO-Acq.5	Formulate/issue RFIs
MIO-Acq.6	Environment/Weather
Develop Situation Understanding	
MIO-SU.1	Correlate Information
MIO-SU.2	Track/VoI Status
MIO-SU.3	Assess Tactical Environ.
MIO-SU.4	Assess Hazards
MIO-SU.5	Assess Urgency
MIO-SU.6	Infer VoI Intent
Course-of-Action	
MIO-CoA.1	Collaborate, Develop CoA
MIO-CoA.2	Simulate CoA
MIO-CoA.3	Present CoA

W-Grp.5	Capabilities/Task Match
W-Grp.6	Adaptation
W-Grp.7	Workload
Human	
W-Hum.1	Competence
W-Hum.2	Task Understanding
W-Hum.3	Performance
W-Hum.4	Capabilities/Task Match
W-Hum.5	Adaptation
W-Hum.6	Workload
Multi-Organization Workflow	
W-MOrg.1	Organization Structure
W-MOrg.2	Command Relationships
W-MOrg.3	Organization Dynamics
W-MOrg.4	Situation/Organization Match
W-MOrg.5	Communications Structure
W-MOrg.6	Adaptation
W-MOrg.7	Performance

MIO-CoA.4	Select COA
MIO-CoA.5	Develop Tasking
MIO-CoA.6	Develop Safety Plan
MIO-CoA.7	Disseminate Tasking
Boarding Execution	
MIO-Brd.1	Insure Safety
MIO-Brd.2	Execute Boarding
MIO-Brd.3	Direct Forces
MIO-Brd.4	Cross-Domain Collaboration
MIO-Brd.5	Real-Time Reporting
MIO-Brd.6	Visual/TV Monitoring
MIO-Brd.7	Mission Reports
MIO-Brd.8	Dynamic Re-Tasking
Shipboard Collection	
MIO-Coll.1	CBNRM
MIO-Coll.2	Biometrics
MIO-Coll.3	Ship Information
MIO-Coll.4	Cargo
MIO-Coll.5	Video
Information Dissemination	
MIO-Dis.1	RHIB Relay
MIO-Dis.2	LOS
MIO-Dis.3	VOI Internal
MIO-Dis.4	SATCOM
MIO-Dis.5	OTH
Mission Assessment	
MIO-Ass.1	Real-Time Assessment
MIO-Ass.2	Real-Time Feedback
EM-Ass.3	After-Action Assessment
EM-Ass.4	Database Update
EM-Ass.5	Assessment Dissemination

Table 12 contains principal attributes for MDA activities and test foci. For each attribute there is included an application which, indicates the type of measure that is to be produced. Neither the attributes nor their application is complete; others may be used in developing a test. Application is shown rather than an actual measure for simplicity, showing the focus.

Table 12. Program Area Activity / Focus and their Attributes and attribute applications (on following pages 33-37).

Program Area Activity / Focus	
Attribute	Application
DT Detect/Track	
DT-SD Ship Detection	
Extensive	area covered, % of AOR
Accurate	location and ID
Timely	reporting delays, alerts
Efficient	collection planning
Persistent	collection, monitoring
Capacity	simultaneous # of ships
Deployable	detection system
Reach	detection range
DT-ST Ship Tracking	
Accessible	area to be monitored
Available	information to users
Persistent	tracking
Efficient	handoff
Accurate	location and ID
Timely	reporting delay
Automatic	tracking and alerting
DT-Acq Acquire Database Information	
Accessible	repository to users
compatible	information formats, systems
Available	repository information
Robust	against penetration, corruption
Capacity	information throughput
Reliable	information availability
DT-Int Intelligence Collection	
Accurate	data/information collected
Sufficient	ISR resources
Timely	RFI response, I&W alerts
Trusted	data sources
Assured	data pedigree
Compliant	priorities to requirements
Relevant	collection plan to requirements
Available	information sources
Persistent	collection

Program Area Activity / Focus	
Attribute	Application
Proc Process Data & Information	
Proc-ID	Identify Ship's Data
Capacity	# of tracks, data amount
Accurate	ship/data association
Automatic	data entry, categorization
Assured	data pedigree
Proc-Cfy	Classify Information
Efficient	automation, personnel savings
Timely	time to classify
Assured	information pedigree
Accurate	classification, track number
Automatic	classification
Proc-Crl	Correlate Information
Capacity	number of ships, sources
Compatible	data formats, systems
Flexible	number of source types
Assured	data pedigree, source
Automatic	ID, correlation
Timely	time per ship
Proc-Fus	Fuse Information
Capacity	number of ships, sources
Compatible	data formats, systems
Flexible	number of source types
Assured	data pedigree, source
Automatic	fusion
Timely	time per ship
Accurate	ship association

Program Area **Activity / Focus**	
Attribute	Application
Analyze/Develop SA	
Develop Profiles	
Automatic	profile generation, correlation
Automatic	Anomaly Detection
Timely	alerts
Flexible	number of profile types
Accurate	profiles, threat ID
Clear	profile structure, relationships
AD-Prof.3	Correlate With Ship Information
Request Information	
Relevant	information gap ID
Available	information sources
Timely	RFI development, submission
Compliant	request format
Classify Vessels	
Accessible	reference data, including M2M
Capacity	# of classifications, data amount
Automatic	classification, VoI ID, prioritization
Available	required data sources
Prioritize Information	
Sufficient	information for prioritization
Relevant	priorities to situation
Flexible	# of priority types
Compliant	priorities with orders, situation
Capacity	# of tracks prioritized

Program Area Activity / Focus	
Attribute	Application
Distribute/Share	
Distribution Means	
Compatible	data, systems, protocols
Deployable	to platforms, units
Capacity	bandwidth, # paths, throughput
Manageable	auto-failover, status reports
Automatic	prioritization, means, distribution
Accurate	data drops, jitter
Collaborate	
Available	collaboration toolkit
Reliable	tools availability, functionality
Flexible	presentation means
Timely	time to join, establish session
Reach	number of users
Manageable	reconfigurable, user & status rpts.
Disseminate	
Timely	transmission time, alerts
Available	selected transmission option
Reach	distribution area, # of customers
Robust	automatic redirect, jamming
Automatic	distribution recipient, alerts
Persistent	network available
Flexible	# of distribution options
Assured	delivery receipt

Program Area **Activity / Focus**	
Attribute	Application
Database Archive/Retrieve	
Deploy Databases	
Capacity	storage, information types
Manageable	automated recovery, status reports
Compatible	systems, protocols interoperability
Acquire Information	
Automatic	data pull, archiving
Available	external data, data to users
Accessible	user to repository, data pull
Compatible	systems, formats
Flexible	source types, data types. Formats
Authenticate Information	
Assured	source logging, pedigree, marking
Compliant	with standards
Manage Access	
Extensive	# of users, profiles managed
Flexible	# of user types, networks
Secure	# unauthorized uses
Persistent	access, down time
Manageable	set-up efficiency, profiles
Assure Information	
Extensive	IA across domains
Robust	backup, failover, down time
Sufficient	IA processes and systems
Available	repository monitoring
Manageable	status reports accuracy, access
Timely	defect repair
Automatic	status reporting and alerting

Program Area Activity / Focus	
Attribute	Application
Guidance	
TTP & SOP	
Available	promulgated and on hand
Compatible	across nations and units
Compliant	with doctrine & directives
Flexible	alternate actions described
Trusted	outcomes produced
Relevant	applies to the situation
Clear	directions
CONOPS	
Available	promulgated and on hand
Compatible	across nations and units
Compliant	with doctrine & directives
Flexible	alternate actions described
Trusted	outcomes produced
Relevant	applies to the situation
Clear	directions
Standing Orders	
Available	promulgated and on hand
Compatible	across nations and units
Compliant	with doctrine & directives
Flexible	alternate actions described
Trusted	outcomes produced
Relevant	applies to the situation
Clear	directions
Cross-Organization Agreements	
Compatible	national doctrine, CONOPS
Available	in existence
Clear	understood at all levels
Extensive	# of situations
Sufficient	coverage of situation

Program Area **Activity / Focus**	
Attribute	Application
Workflow	
Task Assignments	
Sufficient	task coverage, information products
Efficient	task performance, work required
Clear	personnel understand
Timely	information for task
Flexible	to changing technologies, situations
Compatible	across MOCs and units
Organization	
Efficient	task performance, work required
Compatible	across MOCs, units, and nations
Sufficient	covers requirements, needs
Flexible	to changing CONOPS, agreements
Timely	information delivery
Trusted	decision processes
Group	
Flexible	to changing missions
Manageable	for personnel turnover
Compatible	skills match tasks
Capacity	to handle workload
Sufficient	training to achieve competence
Deployable	for command portability
Human	
Flexible	to task assignments, workflow
Sufficient	training to achieve competence
Compatible	skills to task match
Robust	to changing situation
Capable	task performance
Accurate	task performance
Capacity	workload
Multi-Organization Workflow	
Flexible	to different missions, situations
Clear	cross-organization task handoff
Trusted	cross-organization products
Compatible	cross-organization workflow
Compatible	cross-organization products

Program Area Activity / Focus	
Attribute	Application
E-MIO Operations	
Information Acquisition	
Available	needed info and databases
Sufficient	information for assessments
Relevant	information applies to situation
Accurate	information
Timely	information updates, freshness
Develop Situation Understanding	
Capacity	number of ships evaluated
Efficient	time required per ship
Flexible	information types, ship types
Sufficient	SU for CoA development
Relevant	evaluation to situation
Compatible	with command priority
Course-of-Action	
Efficient	CoA development time
Flexible	CoA considered, options
Relevant	to situation, command priority
Compliant	with command priority
Sufficient	information for CoA decision
Timely	in time for execution
Clear	CoA options, actions
Boarding Execution	
Clear	tasking, execution reports
Timely	execution of tasking
Accurate	taking execution
Flexible	immediate situation response
Deployable	execution forces
Sufficient	forces for execution
Reliable	execution reporting
Compliant	execution with directions
Shipboard Collection	
Accessible	ship, personnel, manifests
Capacity	total biometrics
Accurate	data collection
Timely	data collection

Trusted	data collection devices
Sufficient	data collection for threat eval
Information Dissemination	
Accessible	comms paths, internal & external
Capacity	throughput
Timely	data receipt
Manageable	communications architecture
Secure	communications paths
Flexible	path switching, data formats
Mission Assessment	
Sufficient	assessment for decisions
Clear	assessment for decisions
Timely	in time for re-tasking
Relevant	to situation, priorities, intent
Accurate	relation to ground truth

Appendix E
Mapping to JCIDS JCAs

Mapping MDA activities to the JCIDS JCAs is not part of this project. However, it may be useful at some point to do so. The purpose of this appendix is to illustrate the method that has been developed to do such mapping.

Structures and methods have been developed for NAVNETWARCOM to map their capabilities lists to the JCIDS JCAs. (See "Mapping Experiment Results to Operational Capabilities", NPS-97-08-001, Nov 2007). Mapping is done through correlation of operational activities using an Operational Activities Set. The MDA program objectives presented in this report are consistent with the Operational Activities Set.

E.1 Operational Activity Set

The JCAs include supporting and supported activities. The supported activities structure follows the classic OODA loop. The supporting activities are generally accepted to be Net-Centric Operations, Battlespace Awareness, and C2. In addition to OODA, they have their own structure, designated "Service", to include such things as network installation.

The Operational Activity Set has a 3-level structure:

- Level-1, Operational Area (e.g., land operations, surface warfare, battlespace awareness).
- Level-2, Activity Category
    - Observe
    - Orient
    - Decide
    - Act
    - Service
- Level-3 contains Activity Types under each of these Categories
- Level-4 contains Tasks under each Activity Type

Table 13 lists the Activity Categories and Types. The chronological view of activities presented in Table 13 is the most intuitive and illustrates information development. For example, the table shows that data is processed into information in the Observe phase, distributed, then acquired and processed into SA in the Orient phase (note the overlaps of distribute and acquire to illustrate their overlap and interdependence).

Observe	Orient	Decide	Act	Service
Ob-Plan				*Continuous*
Ob-AcqD				|
Ob-ProcD				S-Plan
Ob-DisI	Or-AcqI			|
	Or-ProcI			S-Acquire
	Or-DevSA			|
	Or-ShrSA			S-Manage
	Or-PntSA	D-AcqK		|
	Or-Guide	D-DevSU		S-Assure
		D-ShrSU		|
		D-DevCoA		S-Authorize
		D-PntCoA		|
		D-CoA		S-Distribute
		D-DevT		|
		D-DisT	A-AcqT	S-Instruct
			A-DisUT	|
			A-Ex	|
			A-ExMon	|
			A-ExRprt	|

D = Data
I = Information
K = Knowledge
SA = Sit. Aware.
SU = Sit. Under.
T = Tasking
Mon = Monitor
Rprt = Report
Ex = Execute
Acq = Acquire
Proc = Process
Dis = Distribute
Shr = Share
Dev = Develop
UT = Unit Tasking
Guide = Guidance

Table 13. Chronological Operational Activities Category and Type.

Table 14 presents a view of the set that illustrates the commonality of activities across the OODA categories.

Activity Type	Category				
	Observe	Orient	Decide	Act	Service
Plan	Ob-Plan				
Acquire	Ob-AcqD	Or-AcqI	D-AcqK	A-AcqT	Plan
Process	Ob-ProcD	Or-ProcI			
Develop		Or-DevSA	D-DevSU		Acquire
			D-DevCoA		
Distribute	Ob-DisI	Or-ShrSA	D-DisT	A-DisT	Manage
Present		Or-PntSA	D-PntSU		
			D-PntCoA		Assure
Execute				A-Ex	
				A-ExMon	Authorize
				A-ExRprt	
Guidance		Or-Guide	D-CoA		Distribute
			D-DevT		

					Instruct

Table 14. Operational Activity Set sorted by Activity-Type.

A complete description of the Operational Activity set is found in the NPS report: "Mapping Experiment Results to Operational Capabilities", NPS-97-08-001, Nov 2007.

E.2 Mapping MDA Test Results

Mapping MDA test to the MDA program is, of course direct. Mapping to other areas is done via the Operational Activity Set and the mapping of that Set to those areas. The process is straightforward and Figure 4 illustrates its rudiments.

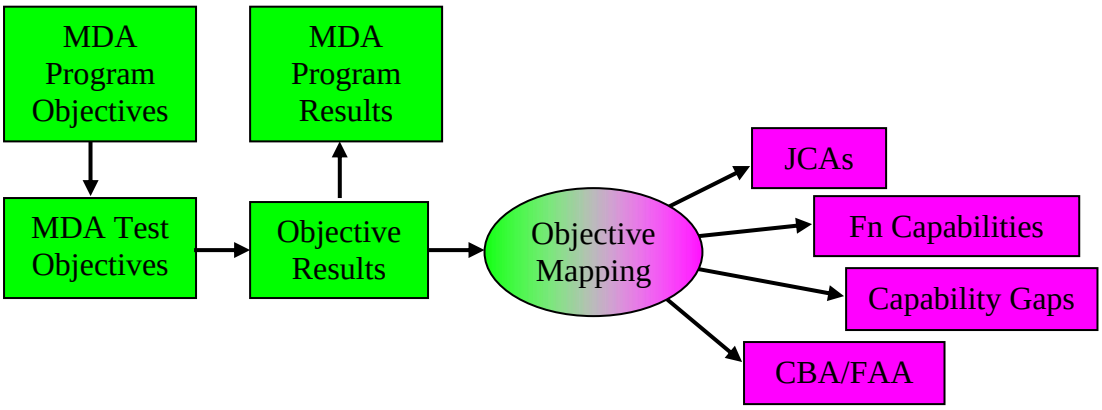

Figure 4. Mapping MDA results to MDA program objectives and to other areas.

5. MDA in the FIRE Knowledge Management System

NPS has developed the FORCEnet Innovation and Research Enterprise (FIRE) to provide complete support for experiment and test planning and reporting. An MDA section has been set up in FIRE, implementing the structure described above. In this chapter, we describe the system's capabilities and how it is used.

It is important to recognize that the objective statements in FIRE are Test Objectives. They are the actual objectives to be achieved and their status addressed in a test venue

5.1 FIRE Structure

FIRE has two basic sections, Planning Forms and Workspace:

Planning Forms

- Detailed planning is accomplished through entries in pre-set forms.
- There are three sets of planning forms
  - Objective
  - Data/Events
  - Results
- Each forms set includes
  - Input/Edit form
  - Report that shows the current planning database content

Workspace

- Contains collaboration capabilities and folders for information to be shared
- Pre-created folders and user defined folders
- Check-in/check-out library for document version control

Following is a depiction of the principal components of the planning forms.

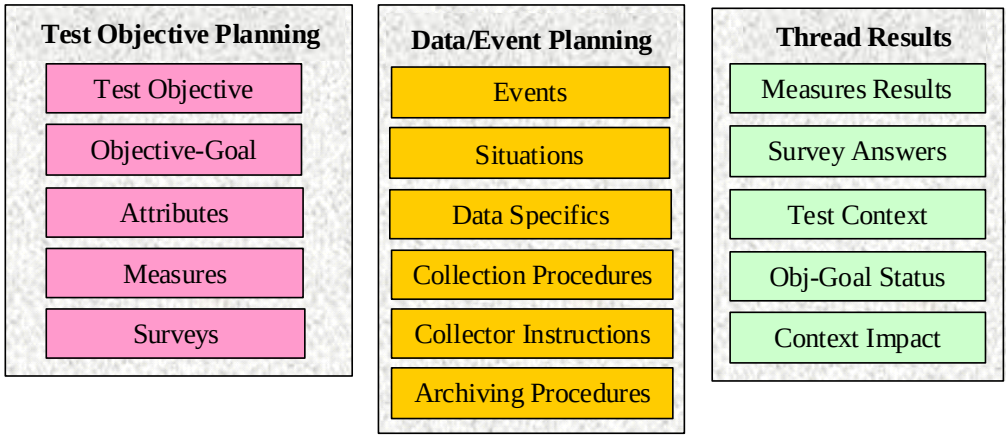

Figure 1. Principal components of the MDA planning forms in FIRE.

Initial Distribution List

1. The Naval Postgraduate School — 1
   1411 Cunningham Road, Code 06IS
   Monterey, CA 93943

2. Dudley Knox Library, Code 013 — 1
   Naval Postgraduate School
   Monterey, CA 93943-5100

3. Research Office, 09 — 1
   Naval Postgraduate School
   Monterey, CA 93943

4. Defense Technical Information Center — 2
   8725 John J Kingman Road, Suite 0944
   Fort Belvoir, VA 22060-6218

5. CDR Dan Dunaway — 1
   Office of the Deputy Under Secretary of the Navy
   1000 Navy Pentagon, Room 4E720
   Washington, DC 20350-1000

6. Mr. Richard Volkert — 1
   Commanding Officer
   (Attn: R. Volkert, Bldg 1 Rm A526)
   Space & Naval Warfare Systems Center – Pacific
   53560 Hull Street
   San Diego, CA 92152-5001

7. LTC Mark J. Gruber — 1
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   Joint Integrated Command and Control for
   Maritime Homeland Defense Operations (JICM)
   JICM JT&E
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9. Mr. George Galdorisi (Via e-mail) 1

10. Dr. Douglas J. MacKinnon (Via e-mail) 1

11. Dr. Shelley Gallup (Via e-mail) 1

12. Mr. Jack Jensen (Via e-mail) 1

13. Ms. Susan Hutchins (Via e-mail) 1

14. Dr. Gordon Schacher (Via e-mail) 1

15. Mr. David Rousseau (Via e-mail) 1